# IEEE VANCOUVER CONTACT

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## IEEE Vancouver 2016 AGM

Please join us for AGM 2016. We have an exciting evening planned for our members and friends. Enjoy a great venue, delicious food, an outstanding keynote speaker and an opportunity to network with friends and colleagues! Members and non-members all welcome.

### Hi-lites

- Student poster competition
- Section AGM, results, plans
- Awards and scholarships
- Prizes!!

### Sponsors

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BC Hydro

### Keynote

**The importance of infrastructure investment**

**Chris O'Riley - Deputy CEO**
**BC Hydro**

**24 March**
**18:00 to 21:00**

**Hilton Metrotown**
**Burnaby, BC**

**Tickets and registration:**
**http://vancouver.ieee.ca/AGM2016**

**Info - Rama Vinnakota**
**IEEE Vancouver Vice-Chair**
**rama.vinnakota@gmail.com**

Kate A. Remley
NIST,Boulder,CO

**Distinguished Lecturer**

# Over-the-Air testing of large cellular wireless devices in reverberation chambers: methods for loading and verifying chamber performance

While the smartphone comes to mind when cellular technology is mentioned, the number of machine-to-machine device applications is also on the rise. These devices may take on large form factors such as parking kiosks, vending machines, car dashboards and the fast growing area of wearable devices that must be tested on body phantoms. Reverberation chambers can provide a relatively low-cost, repeatable laboratory environment for testing these larger cellular wireless devices. However, for some key metrics, the chamber set-up must provide channel conditions similar to those in which the receiver was designed to operate. This may require additional loading of the chamber, complicating both test procedures and uncertainty analyses. We discuss methods for configuring reverberation chambers and assessing uncertainty in the measurement of large-form-factor cellular devices.

**Speaker:** Kate A. Remley (S'92-M'99-SM'06-F'13) was born in Ann Arbor, MI. She received the Ph.D. degree in Electrical and Computer Engineering from Oregon State University, Corvallis, in 1999. From 1983 to 1992, she was a Broadcast Engineer in Eugene, OR, serving as Chief Engineer of an AM/FM broadcast station from 1989-1991. In 1999, she joined the RF Technology Division of the National Institute of Standards and Technology (NIST), Boulder, CO, as an Electronics Engineer. She is currently the leader of the Metrology for Wireless Systems Group at NIST, where her research activities include development of calibrated measurements for microwave and millimeter-wave wireless systems, characterizing the link between nonlinear circuits and system performance, and developing standardized test methods for RF equipment used by the public-safety community.

Dr. Remley was the recipient of the Department of Commerce Bronze and Silver Medals, an ARFTG Best Paper Award, and is a member of the Oregon State University Academy of Distinguished Engineers. She was the Chair of the MTT-11 Technical Committee on Microwave Measurements from 2008 - 2010 and the Editor-in-Chief of IEEE Microwave Magazine from 2009 - 2011, and is the Chair of the MTT Fellow Committee.

Friday 18 March
4:00 - 5:00 pm

Room 418
Macleod Building
2356 Main Mall
UBC

**Information**
Joint Aerospace and Electromagnetics Chair
Dave Michelson
davem@ece.ubc.ca

IEEE Joint Aerospace and Electromagnetics Chapter

Nick McKeown
Stanford University

Monday 29 February

Room 2020 / 2030
Fred Kaiser Building
2332 Main Mall, UBC

Refreshments at 3:15
Presentation at 3:30pm

# Software-Defined Networking

Software-Defined Networking (SDN) has been successful because it lets network owners and operators "program" network behavior. Today, owners and operators of large networks take it for granted that they can commission, write or buy software to manage their network. But SDN's programmability is confined to the network control plane. Conventional wisdom says that if we want the forwarding plane to be programmable, we must pay a large penalty in terms of performance and power. In about 2010, we started to challenge the conventional wisdom and I am now convinced it is no longer true.

I will explain why in the talk; and will describe a new breed of programmable high-performance forwarding chips following the PISA architecture (Protocol Independent Switch Architecture). To program PISA devices we will need a domain specific language, in which programmers declare the forwarding behavior they want. P4 is such a language and is gaining wide traction as a way to write portable, target-independent programs to run on PISA devices.

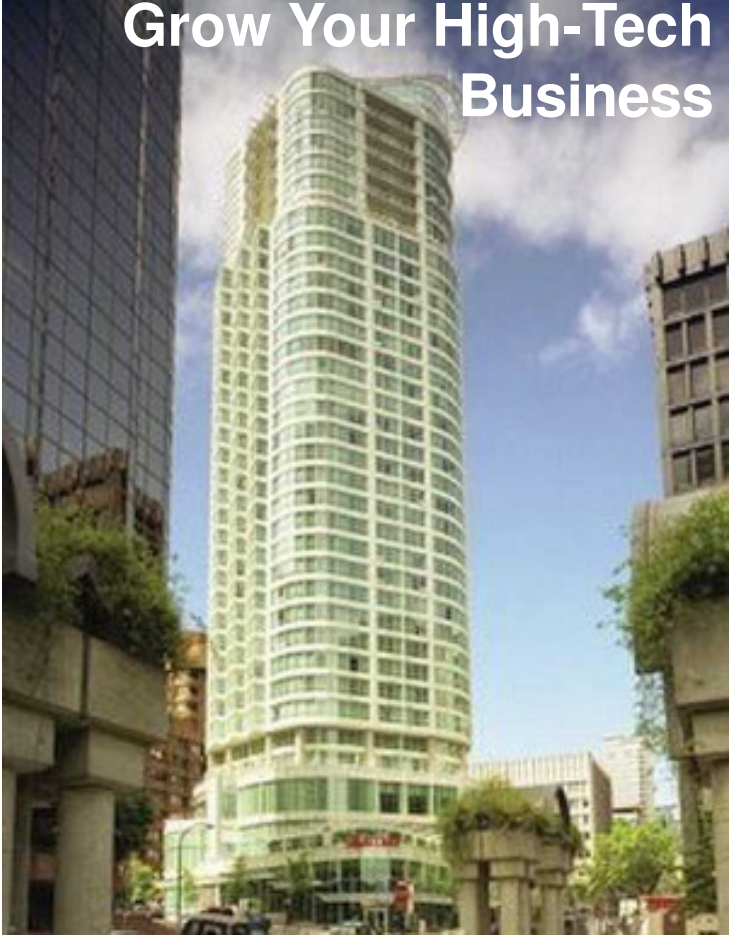
In P4, the programmer declares how packets are to be processed, and a compiler generates a configuration for a protocol-independent switch chip or NIC. For example, the programmer might program the switch to be a top-of-rack switch, a firewall, or a load-balancer; and might add features to run automatic diagnostics and novel congestion control algorithms. In this talk, I will explain why high performance programmable switches are inevitable, give a brief primer on P4, and explain how this will transform how we program and use the network.

**Speaker:** Nick McKeown (PhD/MS UC Berkeley '95/ '92; B.E Univ. of Leeds, '86) is the Kleiner Perkins, Mayfield and Sequoia Professor of Electrical Engineering and Computer Science at Stanford University, and Faculty Director of the Open Networking Research Center. From 1986-1989 he worked for Hewlett-Packard Labs in Bristol, England. In 1995, he helped architect Cisco's GSR 12000 router.
Nick was co-founder and CTO at Abrizio (acquired by PMC-Sierra, 1998), co-founder and CEO of Nemo ("Network Memory"),acquired by Cisco, 2005. In 2007 he co-founded Nicira (acquired by VMware) with Martin Casado and Scott Shenker. Nick is chairman of Barefoot Networks which he co-founded with Pat Bosshart and Martin Izzard in 2013. In 2011, he co-founded the Open Networking Foundation (ONF) with Scott Shenker; and the Open Networking Lab (ON.Lab) with Guru Parulkar and Scott Shenker.

Nick is a member of the US National Academy of Engineering (NAE), the American Academy of Arts and Sciences, a Fellow of the Royal Academy of Engineering (UK), the IEEE and the ACM. He received the British Computer Society Lovelace Medal (2005), the IEEE Kobayashi Computer and Communications Award (2009), the ACM Sigcomm Lifetime Achievement Award (2012), the IEEE Rice communications theory award (1999). Nick has an Honorary Doctorate from ETH (Zurich, 2014). Nick's current research interests include software defined networks (SDN), network verification, video streaming, how to enable more rapid improvements to the Internet infrastructure, and tools and platforms for networking research and teaching.

**Information**
Colleen Brown
colleenb@ece.ubc.ca

ece Electrical and Computer Engineering




As part of this year's Canadian Conference on Electrical and Computer Engineers (CCECE) IEEE Vancouver in partnership with IEEE Canada is sponsoring an industry forum on Vancouver's technology ecosystem.

***Save the date 18 May 1:00 PM Marriott Pinnacle***

On the Wednes day afternoon of May 18 speakers from the major support tech development elements will be speaking on their role in the local technology scene and how they can help support your company's development.

Speakers will include leaders from the government support bodies (NSERC, IRAP, BCIC, etc.), industry support organization such as BCTIA and incubators, and conclude with company leaders who have used the local technology support ecosystem to develop and grow their businesses.

The event is free, but entrance will require advanced registration.
Please visit the CCECE web site (http://ccece2016.ieee.ca/) for a registration link.

M. Angela Sasse
University College London

Monday 14 March

Room 2020 / 2030
Fred Kaiser Building
2332 Main Mall, UBC

Refreshments at 3:15
Presentation at 3:30pm

**Information**
Colleen Brown
colleenb@ece.ubc.ca

## 'Smile to pay'? Only if you are joking

Passwords as a means of identifying users have 'expired', to borrow a fitting phrase from Wired Magazine. Long and complex passwords have induced password fatigue in users, and almost weekly news of password databases at major online providers being breached does not inspire confidence. 2 factor solutions have been deployed in online banking, but high cost and customer complaints are prompting a re-think. Biometric solutions are rapidly gaining ground for payments, especially on mobile phones - Apple's Touch ID and face recognition in particular. This talk will examine the usability, user acceptance and security issues associated with these forms of authentication.

**Speaker:** M. Angela Sasse is the Professor of Human-Centred Technology and Head of Information Security Research in the Department of Computer Science at University College London, UK. A usability researcher by training, she started investigating the causes and effects of usability issues with security mechanisms in 1996, and her 1999 'Users Are Not the Enemy' paper (co-authored with Anne Adams) is the most cited Usable Security paper. She is currently the Director of the UK Research Institute for Science of Cyber Security - a virtual multidisciplinary research collaboration conducting empirical studies on the impact of security measures. She was elected a Fellow of the Royal Academy of Engineering in 2015.

ece Electrical and Computer Engineering

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ICICS-ECE-IEEE Workshop:

ICICS CONNECTING KNOWLEDGE

ece Electrical and Computer Engineering

# SMART CONNECTIVITY

FRIDAY 01 APRIL 2016 — 830 AM - 430 PM
Room 2020 Kaiser Building - 2332 Main Mall - UBC Vancouver Campus

For free registration, technical program and other details, please visit:

**www.icics.ubc.ca/workshops/comm2016**

# Events — under construction

Upcoming events being organized for presentation during March
VISIT WWW.IEEECONTACT.ORG FOR UPDATES TO THE ONLINE EDITION OF MARCH 2016 CONTACT

Tuesday 08 March
4:30pm to 6:00pm

Southpoint BC Hydro
6911 Southpoint Drive,
Burnaby, BC

**Information**
Jeff Bloemink
JointIAS/IES Chair
j.m.bloemink@ieee.org

## "Meet and Learn" Technical society reporting out session

IEEE Vancouver Industry Applications and BC Hydro co-sponsor this technical society reporting out event. Food and refreshments will be provided. Details of the March 08 talks will update the onliine March 2016 Contact edition at www.ieeecontact.org and at http://vancouver.ieee.ca/. You can also contact Bob Stewart at bob.stewart@bchydro.com or IAS Chair Jeff Bloemink at j.m.bloemink@ieee.org.

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Monday 14 March

2:30-3:30

5-174
PG Main Campus

**Information**
Matt Reid
IEEE UNBC Chair
mreid@unbc.ca

## Biomedical imaging at the BC Cancer Agency

**Speakers:**
Dr. Quinn Matthews
Dr. Nick Chng
Mrs. Kimberly Lawyer

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Monday 21 March

**Information**
CS/RA/SMC
Joint chapter Chair
Ryozo Nagamune
nagamune@mech.ubc.ca

**Speaker:**

## James Rawlings
## University of Wisconsin

http://directory.engr.wisc.edu/che/faculty/rawlings_james

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Tuesday 29 March
9:00 - 4:00pm

Kwantlen Polytechnic U
conterence centre
Richmond campus

**Information**
Continuing Educ.Chair
Bob Gill
bgill@ieee.org

## Symposium on cybersecurity and digital forensics: current research and developments

Details will be posted to the online edition of March 2016 Contact as available and on the IEEE Vancouver website.

This event is sponsored by IEEE Vancouver Continuing Education

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Wednesday 30 March
2:30-3:30

5-174
PG Main Campus

**Information**
Matt Reid
IEEE UNBC Chair
mreid@unbc.ca

## Ariel project (TRIUMF)

**Speaker:**
Dr. Greg Hackman

## Physics in radiation oncology

Dr. Nick Chng
Dr. Quinn Matthews
Mrs. Kim Lawyer
BC Cancer Agency

Monday 14 March

2:30-3:50 pm

Room: 5-174
Prince George campus

Medical physics is the study of the applications of physics in medicine including radiation protection, diagnostic imaging, and radiation oncology. This lecture will introduce the history of radiation in therapy and the role of a medical physicist, as well as discuss the physical interactions and radiobiological effects of ionizing radiation used in diagnostic and therapeutic treatments of cancer.

An overview of the radiation treatment planning system will be given, that is, what is the process of a patient going through their radiation therapy. A significant part of the treatment planning process is the determination of the dose used in a patient's treatment. A discussion of the evolution and types of dose calculation algorithms will be presented. There is a lot of behind-the-scenes work that goes into ensuring that a patient's radiation treatment is delivered as expected.

The last part of the lecture will describe some quality assurance techniques (including the planning system, radiation beam, and mechanical components) and radiation detectors used to ensure that:

- treatment plans are delivered correctly and safely within specified tolerances and
- the equipment operates to meet these standards.

**Information**
Matt Reid
IEEE UNBC Chair
mreid@unbc.ca

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

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## Financial Tools 101

Wednesday 02 March

6:00pm to 7:30pm

BCIT Downtown Campus
555 Seymour St
Vancouver

Snacks, networking, and a lot of information about financial planning

Financial Tools 101 is a short and sweet seminar that will give you a broad overview of financial tools that can be used to grow your wealth. Financial growth takes time, and this seminar will prove to you why slow and steady continuous deposits using these tools will help you grow your wealth immensely.

**Speaker:** Brandon Chapman helps young professionals and business owners identify what they want for their financial future and then guides them on the best route to get there. His interests include finance & technology which were fuelled by his education at the Beedie School of Business. Brandon spends his spare time giving back to the SFU community through mentorship and recruitment while keeping himself in shape by snowboarding and surfing.

Key topics that will be covered are:

- Paying yourself first
- Long term investing vs short term speculating
- Tax deferred savings accounts (RRSP & TFSA)

Your greatest asset: offence and defence in an overall financial security plan

**Speaker:** Greg Taylor is a Certified Financial Planner (CFP) and has been helping clients achieve their financial goals with Freedom 55 Financial for 18 years. He currently is the director of business development at the Vancouver-Georgia financial centre where he coaches advisors as they establish their practise. Greg spends his spare time working on a variety of causes with Kiwanis as well as raising his daughter Keira.

Postponed

Registration
http://www.eventbrite.com/e/financial-tools-101-tickets-22073106255?aff=Contact

**Information**
Sean Garrity, Chair
IEEE youngprofessionals
sean.garrity.ca@ieee.org

IEEE youngprofessionals

# *Welcome.. 250 arrivals to IEEE Vancouver!!*

Amirreza Abbasnejad ..... M
Nafis Abrar ..... ST
Mazy Abulnaga ..... ST
Sachin Achuthan ..... ST
Peter Aeberhardt ..... M
Anushka Agarwala ..... ST
Marjan Alavi ..... GS
Abdelmalik Aljalai ..... GS
Khalid Almutiri ..... ST
Mohammad AL-Qaderi ..... ST
Muhammed AlRasheedi ..... GS
Nabil Al-Rousan ..... GS
Maron Amaro ..... ST
Ahmed Arafa ..... GS
Abdalrahman Arafeh ..... GS
Nazir Arain ..... M
Daniel Atkinson ..... ST
Andrew Azmy ..... ST
Kris Baranowski ..... ST
Ryan Bentley ..... ST
Bryan Bergen ..... ST
Charlton Berry ..... ST
Nadine Bhagwansingh ..... M
Abhijit Bhattacharya ..... ST
Sanika Bhide ..... ST
Ronan Boitard ..... M
Carlos Borges ..... ST
Sean Bouchard ..... M
Rob Bro ..... GS
Minh Bui ..... ST
Daniel Busto ..... M
Justin Carroll ..... M
Heath Caswell ..... ST
Sunmeet Chahal ..... ST
Lok Shan Chan ..... M
Francis Charbonneau ..... ST
Kenneth Chau ..... M
Jianhui Chen ..... GS
Zhu An Chen ..... M
Derek Chen ..... ST
Nancy Chen ..... ST
Yung-Hsuan Chiu ..... ST
Angela Cho ..... ST
Dong-Wan Choi ..... AM
Wonbae Choi ..... GS
Jordan Cho-Siksik ..... ST
Steven Chu ..... ST
Angy Chung ..... ST
Devin Cowan ..... GS
Miriam Cunha Castillo ..... ST
Maverick Cuyugan ..... ST
Ke Dai ..... GS
Udit Narayan Das ..... ST
laleh Dastmalchi ..... M
Joao Rafael de Araujo ..... ST
Steven Dean ..... ST
David Degraaf ..... M
Brian Denheyer ..... M
Qingye Ding ..... GS
Nicholas Dohmeier ..... M
Anthony Duen ..... ST
Declan Easton ..... ST
Seyyedmilad Ebrahimi ..... GS
J. Bradley Edwards ..... M
Ahmed Elnady ..... GS
Bara Emran ..... GS
Martin Ester ..... AM
Shaizaib Faisal ..... ST
Bo Fang ..... GS
Ben Farrell ..... GS
Elaine Feng ..... ST
Reza Filsoof ..... ST
Jason Finishen ..... M
Kurt Fitz ..... ST
Joe Forcina ..... M
Sarah Foss ..... ST
Corey Frank ..... ST
Di Fu ..... ST
Michael Fujiwara ..... ST
Rob Fuller ..... M
Matthew Gadsby ..... ST
Logan Geefs ..... ST
Megan Gent ..... ST
Amin Ghasemazar ..... GS
Vishakha Ghosh ..... ST
Lovedeep Gondara ..... GS
Christopher Green ..... M
Ankur Gupta ..... GS
Michael Gverzdys ..... M
Kevin Hall ..... ST
Mustafa Hammood ..... ST
Cole Harkness ..... ST
Md Zohed Hassan ..... GS
William Hoiles ..... GS
Arabelle Hou ..... ST
Ilija Hristovski ..... ST
Xin Huang ..... ST
Andrew Hughes ..... M
Yinjia Huo ..... GS
Syed Ibnul Hussain ..... ST
Georgia Iredale ..... ST
Dejan Ivkovic ..... M
shawn Jahromi ..... ST
Mukul (Mike) Jain ..... M
Nathalie Janssen ..... ST
Hasitha Jayatilleka ..... GS
Ruotong Jia ..... ST
Vladimir Jovicic ..... M
Matt Karpa ..... ST
Deepak Kaushal ..... M
Jeremy Kawahara ..... GS
Noor Khan ..... ST
Rahul Khandekar ..... M
G Khoshkholgh Dashtaki .... GS
Debbi Kill ..... AM
Maria Kim ..... M
Alexandra Kitson ..... ST
Gurbinder Kooner ..... M
Chon San (Kelvin) Kou ..... ST
Alexander Kroitzsch ..... ST
Tommy Lau ..... ST
Joanna Leung ..... ST
Qian Li ..... M
Minchen Li ..... GS
Yuzhou Li ..... ST
Jenny Lian ..... ST
Hongwei Liang ..... GS
Ran Liao ..... ST
Ursula Anne Lim ..... ST
Shen Chieh Lin ..... ST
Wen-Ling Lin ..... ST
Damon Liu ..... M
Francis Lo ..... ST
Darrell Loh ..... GS
Daniel Louie ..... ST
Jordan Lui ..... GS
Scott MacLaren ..... ST
WeiXin Mai ..... ST
Gary Maltsev ..... ST
Cody Martin ..... ST
Raul Martinez ..... M
Amir Masnadi Shirazi ..... GS
Catherine Maydan ..... M
Andrew McCartan ..... ST
Nick McDonald ..... ST
Ian McEachern ..... M
Harshini McLeod ..... M
AnnaLisa Meyboom ..... M
Robert Middleton ..... M
Luke Mitton ..... ST
Paula Isabel Morales ..... ST
Cameron Morgan ..... ST
Linda Munisi ..... ST
David Munoz-Paniagua ..... M
Robert Murdoch ..... M
Reem Mustafa ..... ST
Sohail Nazari ..... M
Bowen Nie ..... ST
Edward Ning ..... ST
Hamed Noori ..... AM
Shahriar Noroozi Zadeh ..... ST
Megan O'Connor ..... GS
Jennifer Ongko ..... ST
Luke Pamula ..... M
Yuting Pan ..... ST
Daniel Papanek ..... ST
Jun Yong Park ..... ST
Eunchul Park ..... ST
Sylvio Pasqua ..... M
Reuben Paul ..... ST
Canute (Paul) Pereira ..... ST
Scott Peverelle ..... ST
Stylianos Ploumis ..... GS
Nikhil Prakash ..... ST
Frederic Renken ..... ST
Hailee Renkers ..... ST
Graeme Rennie ..... ST
Robert Roskell ..... ST
Rouyeen Rouyani ..... ST
Parastoo Saharkhiz ..... M
Raghul Sai Subramanian .... ST
Saif Sajid ..... ST
M Ali Saket Tokaldani ..... GS
Mohammad Foad Samadi .. GS
Farrokh Sassani ..... SM
Jesse Saunders ..... M
Gary Sawatsky ..... M
Timothy Sayler ..... ST
Ryan Schatz ..... M
Michael Schefter ..... M
Jonatan Schroeder ..... GS
Hamza Serkouh ..... ST
Tareq Shahwan ..... GS
Ashaya Sharma ..... ST
Bruce Sharpe ..... M
Michael Shaw ..... M
Shima Shojae ..... GS
Gurekamdeep Sidhu ..... ST
Branden Siegle ..... ST
Ahmed Sigiuk ..... GS
Davneet Singh ..... ST
Janelle Somerville ..... ST
Lu Song ..... ST
Spencer Spenst ..... ST
Jeff Stacey ..... ST
Yk Sugishita ..... ST
Tim Szigeti ..... M
Mark Teolis ..... ST
Karan Thakur ..... ST
Gurman Thind ..... M
Muhab Tomoum ..... ST
Xin Tong ..... GS
Brennan Town ..... M
Neil Traft ..... GS
Maria (Wenting) Tu ..... ST
Muhammad Tufail ..... M
Tugce Tuysuz ..... GS
Carl Julius Ungson ..... ST
Nicolas Veilleux ..... M
Adam Vengroff ..... ST
Fabrice Vieillesse ..... ST
Saurabh Vishwakarma ..... ST
Scott Wallace ..... M
Martin Wallace ..... ST
Tavia Walsh ..... ST
Philip Wang ..... ST
Ping Szu Wang ..... ST
Yun Wang ..... GS
Zemeng Wang ..... GS
Cael Warner ..... ST
Kevin Weiss ..... M
Breanne Wiebe ..... ST
Scott Williams ..... M
Jimmy Wong ..... ST
Ryan Wong ..... ST
Scott Wood ..... M
Kieren Wou ..... ST
Tianyi Xie ..... ST
Ke Er Xiong ..... ST
Evangeline Yee ..... ST
Qassam Yomok ..... ST
David Zhang ..... ST
Guanchen Zhang ..... GS
Zhengyu Zhao ..... ST
Xiangyu Zhao ..... ST
Gang Zheng ..... M
Zhonghua Zhou ..... GS
Siqing Zhu ..... ST
James Zhu ..... ST
Shaghayegh Zihajehzadeh . GS

AF Affiliate - AM Associate - F Fellow - GS Graduate Student - LF Life Fellow LM Life - LS Life Senior - M Member - SM Senior - ST Student

a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA
Chemical & Biological Engineering
Faculty of Applied Science

March 21st, 2016
Distinguished Speaker

# Professor James B. Rawlings

## Optimal Dynamic Operation of Chemical Processes: Assessment of the Last 20 Years and Current Research Opportunities

CHBE Rm 202 at 10:00 – 11:00 AM

This talk, provides a critical assessment of the research progress in the fields of dynamic operation of chemical processes and process control.

## State Estimation using Moving Horizon Estimation and Particle Filtering

Institute of Applied Mathematics (LSK 460) at 3:00 – 4:00 PM

This seminar provides an overview of currently available methods for state estimation of linear, constrained and nonlinear dynamic systems. The seminar begins with a brief overview of the Kalman filter followed by alternatives for treating nonlinear and constrained dynamic systems

## Optimal Dynamic Operation of Chemical Processes: Assessment of the Last 20 Years and Current Research Opportunities

CHBE Rm 202 at 10:00 – 11:00 AM

**Abstract.**

This talk, intended for the general chemical engineering audience, provides a critical assessment of the research progress in the fields of dynamic operation of chemical processes and process control. The following points are discussed:

(i) What new intellectual ideas, concepts, and tools have emerged from this research field during the last 20 years.
(ii) How successfully have the research innovations in problem conceptualization, formulation, and solution been reduced to industrial practice.
(iii) What application areas have benefited from this research.

Next we present a selection of open problems and research challenges. These research challenges are formulated by enumerating the current industrial needs in different application areas, and identifying common themes that can be addressed by developing new tools in systems theory and engineering. We focus on two topics of interest to our research group:

(i) How do we distribute tasks in a large-scale application to a collection of agents/controllers so that the overall system achieves near optimal operation.
(ii) How do we use systems and control tools to address the larger goal of optimizing process economic performance rather than traditional lower level tasks such as set point tracking and disturbance rejection.

## State Estimation using Moving Horizon Estimation and Particle Filtering

Institute of Applied Mathematics (LSK 460) at 3:00 – 4:00 pm

**Abstract.**

This seminar provides an overview of currently available methods for state estimation of linear, constrained and nonlinear dynamic systems. The seminar begins with a brief overview of the Kalman filter, which is the optimal estimator for a linear dynamic system subject to independent, normally distributed disturbances. Next, alternatives for treating nonlinear and constrained dynamic systems are discussed. Two complementary methods are presented in some detail: moving horizon estimation, which is based on optimization, and particle filtering, which is based on sampling. The advantages and disadvantages of these two approaches are presented. Topics for new research are suggested that address combining the best features of moving horizon estimators and particle filters.

**James B. Rawlings** received the B.S. from the University of Texas in and the Ph.D. from the University of Wisconsin, both in Chemical Engineering. He spent one year at the Universityof Stuttgart as a NATO postdoctoral fellow and then joined the faculty at the University of Texas. He moved to the University of Wisconsin in 1995 and is currently the Paul A. Elfers Professor and W. Harmon Ray Professor of Chemical and Biological Engineering and the co-director of the Texas–Wisconsin–California Control Consortium (TWCCC). His research interests are in the areas of chemical process modeling, molecular-scale chemical reaction engineering, monitoring and control, nonlinear model predictive control and moving horizon state estimation. Professor Rawlings has written numerous research articles and coauthored three textbooks: "Modeling and Analysis Principles for Chemical and Biological Engineers" (2013) with Mike Graham, "Model Predictive Control: Theory and Design" (2009), with David Mayne, and "Chemical Reactor Analysis and Design Fundamentals" (2004), with John Ekerdt. He is a Fellow of AIChE and IEEE.